oxidizing the amorphous silicon nitride layer to form a node dielectric layer.

21. (Amended) A method for forming a crystalline silicon nitride layer, comprising the steps of:

providing a crystalline silicon substrate with an exposed surface;

removing a native oxide from the exposed surface;

precleaning the exposed surface by employing a hydrogen prebake less than about one hour after the removing step; and

exposing the exposed surface to nitrogen having a pressure of less than or equal to about one atmosphere to grow a continuous crystalline silicon nitride layer.

REMARKS

This application has been reviewed in light of the Final Office Action dated April 10, 2001. Claims 1-8, 10-16 and 21-28 are now pending in the application. Claims 1, 10 and 21 have been amended. No new matter has been introduced or issues raised by the amendments. The Examiners reconsideration of the rejection in view of the following remarks is respectfully requested.

By the office action, claims 1 and 10 stand rejected under 35 U.S.C. § 112, second paragraph. The Applicant's disagree with the rejection and believe the claims are definite as written. However, amendments have been made to clarify the present invention, which address the Examiner's concerns. Reconsideration of the rejection is respectfully requested.

By the office action, claims 1-8 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,913,149 to Thakur et al. (hereinafter Thakur) in combination

with U.S. Patent No. 4,940,505 to Schachameyer et al. (hereinafter Schachameyer) and further in view of U.S. Patent No. 5,643,823. The Examiner stated that the rejection is maintained from the office action mailed 10/12/00. The Applicants respectfully disagree with the rejection. The Applicants believe that the amendments made to claims 1, 10 and 21 further clarify the present invention. The Applicants also believe that the cited combination of Thakur, Schachameyer and Ho fails to disclose or suggest the present claims.

The present invention includes, *inter alia*, a method for forming a continuous crystalline silicon nitride layer by providing a crystalline silicon substrate with an exposed precleaned surface, removing a native oxide from the exposed surface, precleaning the exposed surface by employing a hydrogen prebake after an elapsed amount of time after the removing step; and exposing the exposed surface to nitrogen to form a continuous crystalline silicon nitride layer.

The present invention provides a continuous crystal or crystalline silicon nitride layer. This layer is not the poly-crystalline layer described in Ho. The RTN processes of Thakur and Ho form an amorphous layer. Rapid thermal nitration (RTN) forms a quick (hence rapid) amorphous layer. This is supported by the disclosure of Ho, which teaches an RTN process, which forms an amorphous SiN layer.

Thakur does not disclose or suggest crystalline silicon nitride, and Ho discloses only a multitude of crystals or crystallites, which include grain boundaries and are therefore discontinuous and are formed by a subsequent annealing process. (see e.g., Ho at col. 3 lines 10-11). These references do not disclose or suggest growing a continuous crystalline silicon nitride layer. Instead, Thakur discloses only forming an amorphous silicon nitride film, and Ho forms an amorphous silicon nitride film and then anneals the film to cause some portions to crystallize.

If the cited references are combined, the SiN layer of Ho would result. This would include an amorphous layer with some crystallites, and not a continuous crystalline silicon layer, as in the present invention. In addition, the crystallites of Ho are not grown, but would be the result of an annealing process. Therefore, the cited references, alone or in combination fail to disclose or suggest growing a continuous crystalline silicon nitride layer.

In addition, the combination of Thakur, Schachameyer and Ho fails to disclose or suggest, *inter alia*, removing a native oxide and then a separate step of precleaning the surfaces after a predetermined amount of time has elapsed by a hydrogen prebake. (See the present specification at page 14, lines 15 -20). Nowhere in the cited references, alone or in combination, is this combination of steps disclosed or suggested.

The present invention is believed to be in condition for allowance for at least these reasons. Given the foregoing, the Examiner is respectfully requested to reconsider the rejection and allow the present claims.

Although the Applicants believe that the originally filed claims are allowable over the cited art, claims 1 and 10 have been amended to further clarify the distinctions of the present invention. The present invention grows a continuous crystalline silicon nitride layer on a crystalline silicon substrate by first cleaning the silicon substrate's surface and then performing a hydrogen prebake process after given amount of time has elapsed after removing the native oxide.

By the office action, claims 10-16 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Thakur in combination with Schachameyer in view of Ho and further in view of Wolf, Vol. 2. page 51. The Examiner stated that the Wolf, Vol. 2 discloses a capacitor in a trench. The Applicants respectfully disagree with the rejection.

As described above, page 51 of Wolf does not teach or suggest a grown continuous crystalline silicon nitride layer, not does Wolf teach or suggest the combination of removing native oxide and precleaning by a hydrogen bake. Accordingly, none of the cited references, alone or in combination, disclose or suggest a grown continuous crystalline silicon nitride or methods for forming the same.

Claims 10-16 are believed to be allowable over the cited art for at least the reasons stated. Reconsideration of the rejection is respectfully requested.

The Examiner is respectfully requested to reconsider the rejection of the dependent claims as well (for example, claim 3, etc.).

The Applicant believes that the present invention is allowable over the cited art. However, the Ho reference and the present invention are believed to be commonly owned. The Examiner is respectfully requested to consider a non-statutory double-patenting rejection. In such a case, the Applicants will consider filing a terminal disclaimer.

In view of the foregoing amendments and remarks, it is respectfully submitted that all the claims now pending in the application are in condition for allowance. Early and favorable reconsideration of the case is respectfully requested.

Respectfully submitted,

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MARKED-UP VERSION OF CLAIMS:

1. (Twice Amended) A method for forming a crystalline silicon nitride layer, comprising the steps of:

providing a crystalline silicon substrate with an exposed precleaned surface;

removing a native oxide from the exposed surface;

precleaning the exposed surface by employing a hydrogen prebake [a predetermined] after an amount of time has elapsed after the removing step; and

exposing the exposed surface to nitrogen to [form] grow a continuous crystalline silicon nitride layer.

10. (Twice Amended) A method for forming a node dielectric layer in deep trenches, comprising the steps of:

providing a crystalline silicon substrate with trenches formed therein, the trenches including exposed silicon surfaces;

removing a native oxide from the exposed silicon surfaces;

precleaning the exposed surfaces by employing hydrogen prebake [a predetermined] after an amount of time has elapsed after the removing step;

exposing the exposed surfaces to ammonia to [form] grow a continuous crystalline silicon nitride layer;

depositing an amorphous silicon nitride layer over the continuous crystalline silicon nitride layer; and

oxidizing the amorphous silicon nitride layer to form a node dielectric layer.

21. (Amended) A method for forming a crystalline silicon nitride layer, comprising the steps of:

providing a crystalline silicon substrate with an exposed surface;

removing a native oxide from the exposed surface;

precleaning the exposed surface by employing a hydrogen prebake less than about one hour after the removing step; and

exposing the exposed surface to nitrogen having a pressure of less than or equal to about one atmosphere to [form] grow a continuous crystalline silicon nitride layer.